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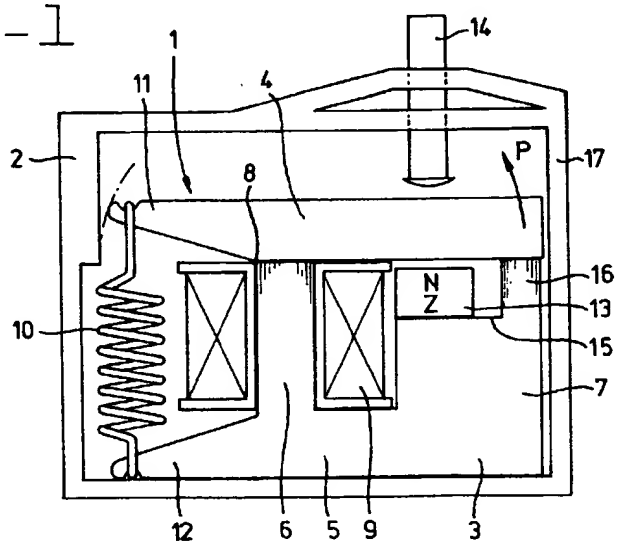
(54) Control unit for an electric switch and method for the manufacture thereof

(57) Control unit (1) for an electric switch, comprising a yoke (3) of magnetic material, an armature (4), a coil (9), a permanent magnet (13) and spring means (10). The yoke (3) consists of a base part (5) and two legs (6,7) which extend at a distance from each other and in the same direction from the base part (5), and at right angles thereto. The armature (4) is made of magnetic material, bridges the free ends of the yoke legs (6,7) and is movably supported. The permanent magnet (13) is fitted in such a way that the magnetic lines of flux run through the armature (4) and the yoke (3). The coil (9) is fitted on the yoke (3). At one side the spring means (10) act upon an armature part (11) extending beyond a yoke leg face which faces away from the other yoke leg, the armature (4) assuming a first position under the influence of the magnetic field of the permanent magnet (13), against the spring force of the spring means (10), and being able to assume a second position under the influence of the magnetic field created by an electric current which flows through the coil (9) and exceeds a preset limit value. At the other side the spring means (10) act upon a yoke projection (12) extending beyond the abovementioned yoke leg face at a distance from the projecting armature part (11). The armature (4) and yoke (3) are made of flat magnetic material.

fig-1



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Description

The invention relates to a control unit for an electric switch, comprising a yoke of magnetic mat rial which consists of a base part and two legs which extend at a distance from each other and in the same direction from the base part, and at right angles thereto, an armature made of magnetic material which bridges the free ends of the yoke legs and is movably supported, a permanent magnet which is fitted in such a way that the magnetic lines of flux run through the armature and the yoke, a coil fitted on the yoke, and spring means which at one side act upon an armature part extending beyond a yoke leg face which faces away from the other yoke leg, the armature being able to assume a first position under the influence of the magnetic field of the permanent magnet, against the spring force of the spring means, and being able to assume a second position under the influence of the magnetic field created by an electric current which flows through the coil and exceeds a preset limit value.

Such a control unit is known from French Patent Specification 2,697,670.

This known control unit can be regarded as a sensitive electromechanical energy converter which can be used for controlling the mechanism of an electric switch or for unlocking the mechanism of an earth leakage switch.

In the non-activated operating state, under the influence of the permanent magnet, the armature is held in the first position against the force effect of the spring means, in which position, for example in the case of an electric switch, the latter can be moved into the conducting state by means of the control unit. If the coil fitted on the yoke is excited by an electric voltage or current, a magnetic field is created, opposed to the effect of the magnetic field created in the yoke by the permanent magnet, with the result that the armature is taken into its second position, under the influence of said magnetic field and of the force effect of the spring means. This occurs if the electric current flowing through the coil exceeds a preset limit value. As a result of the transition from the first to the second position of the control unit, the appropriate switch to be controlled is taken into the non-conducting state. In practice, this will be the case, for example, when earth fault currents occur or when a current to be monitored exceeds a predetermined maximum value in an electrical installation.

For the detection of the above situations, separate means can be used, for example an electronic switch designed for this purpose, by means of which the coil of the control unit can be excited, in order to take the armature into the second position.

The object of the invention is to provide a control unit of the type mentioned in the preamble which is simple in design and is easy to produce and assemble, while the limit value to be preset for the electric current flowing through the coil is accurately defined and/or is easy to set.

This object is achieved according to the invention by the fact that at the other side the spring means act upon a yoke projection extending beyond the abovementioned yoke leg face at a distance from the projecting armature part, and the armature and yoke are made of flat magnetic material.

This means that no separate measures need be used for the point of action of the other side of the spring means. Since the spring means also act at one side upon the armature and at the other side upon the yoke, the assembly of the control unit is simple, and the fully assembled control unit can easily be accommodated as a whole in a housing.

The armature and the yoke are made of flat magnetic conducting material, so that they can be punched in a simple manner out of a sheet or strip of high-grade magnetic conducting material. There is no need for bending, and the accuracy of the punching simplifies the grinding of the contact faces which is necessary for good functioning. Moreover, the design makes it possible to grind several yokes or armatures simultaneously. Owing to the flat construction of the armature, the latter can also be guided in all directions through the housing, without the danger of tilting. Furthermore, the choice of the point of action of the spring on the yoke has the added advantage that during punching of the yoke the point of action is ready immediately, and no additional processing step is now necessary.

In an embodiment of the control unit according to the invention in which said control unit is accommodated in a housing, a stop for the armature in the second position is formed by an opposite wall of the housing, i.e. the wall in the direction of which the end of the armature is moved from the first position away from the corresponding yoke leg to the second position. This means that no separate stop element is needed, and the armature will always return to the same initial position again without further aids, and correct positioning is ensured.

In another embodiment of the control unit according to the invention, the point of action of the spring means on the projecting armature part is situated at a greater distance from the yoke than the face of the armature facing away from the yoke. Owing to the fact that this point of action is placed at a greater distance from the face of the armature facing away from the yoke, a relatively flat force-travel characteristic of the spring means during the movement of the armature from the first to the second position, and vice versa, is achieved.

The abovementioned greater distance is preferably obtained by the projecting armature part being situated at an angle relative to the armature. The advantage achieved here is that the point of action is shifted without increasing the mass of the armature. This is important for reducing the sensitivity to shock.

In another embodiment of the invention, one yoke leg is broader than th other and in the direction of the armature merges into a narrower part, in order to form an accommodation space for the permanent magnet.

Owing to the fact that the yoke is punched out of magnetic sheet material, the design of the yoke can be selected to a large degree as desired. This means that it is simple to adapt the accommodation space for the permanent magnet to the dimensions of said magnet. Moreover, the limit value of the current flowing through the coil of the control unit can be defined accurately by said accommodation space being dimensioned in such a way that the permanent magnet can be slid towards and away from the narrowed leg, in order to make an accurate fine adjustment of the abovementioned limit value.

In an embodiment of the invention which is preferably used, at the armature end which can be moved away from the corresponding yoke leg the magnetically effective surface of said armature is limited in the lengthwise and breadthwise direction of the armature in such a way that said surface corresponds to the end surface of the corresponding yoke leg facing the armature. The result of this is that when the armature end is being moved away from the corresponding yoke leg the magnetic lines of flux fan out less rapidly, so that the control unit is less sensitive as regards air gaps. This is particularly important when corrosion-resistant layers are being applied to the pole surfaces of the yoke, in connection with their thickness(es).

This limitation is preferably achieved by providing the armature at the side facing the yoke legs with a recess which is situated between the yoke legs and adjoins the yoke leg away from which the armature can be moved.

The invention further relates to a method for manufacturing the control unit described above, in which the armature and the yoke are punched out of a sheet of magnetic conducting material, the armature, the yoke, the coil and the permanent magnet are assembled, the spring means are attached to the armature and the yoke, and in which the entire assembly of armature, yoke, coil, magnet and spring means is fitted in the housing, and the housing cover is fixed on the housing.

The invention will be explained in greater detail below with reference to the drawing. In the drawings:

Fig. 1 shows a section through an embodiment of the control unit according to the invention;

Fig. 2 shows a section through a preferred embodiment of the control unit according to the invention; and

Fig. 3 shows a perspective view of an embodiment of the control unit according to the invention, with disassembled parts.

The embodiment of the control unit 1 according to the invention shown in Fig. 1 is accommodated in a housing 2 and comprises a yoke 3 and an armature 4. The yoke 3 is substantially U-shaped and consists of a base part 5 and two yoke legs 6, 7. The armature 4 bridges the yoke legs 6 and 7 and is rotatable in the direction of the arrow P about the pivot point 8.

A coil 9 is fitted around the yoke leg 6, to which coil an electric current can be supplied by connecting an electric voltage thereto.

The control unit also comprises a spring 10, one end of which is attached to an armature part 11, while the other end of the spring 10 is attached to the yoke projection 12. The magnetic field created by the electric current flowing through the coil 9 is oriented in such a way that the force on the armature created by the magnetic field and the spring force of the spring 10 exerted thereon interact in order to make the armature pivot in the direction of the arrow P about the pivot point 8.

A permanent magnet 13 is also present, the lines of flux of which magnet run through the armature and yoke, which lines of flux are, however, directed in the opposite direction to that of the magnetic lines of flux which are created by the electric current flowing through the coil 9.

If no current is flowing through the coil 9, the armature 4 is pressed by the permanent magnet 13 against the spring force of the spring 10 onto the end faces of the yoke legs 6 and 7, and said armature is therefore situated in a first position. However, as soon as the electric current flowing through the coil 9 exceeds a preset limit value, the armature 4 is pivoted in the direction of the arrow P about the pivot point 8, in which case the spring force of the spring 10 and the magnetic field created by the current interact in an opposing manner to the influence of the permanent magnet 13 upon the armature 4. The armature 4 then goes into its second position, in which the control pin 14 is driven in the upward direction, in order to take the mechanism of a controllable switch (not shown), for example an overflow switch or earth leakage switch, into a predetermined position.

The yoke 3 and the armature 4 are preferable punched out of a sheet or strip of high-grade conducting magnetic material. Owing to the fact that during the punching the yoke 3 is directly provided with a projection 12 which serves as a point of action, the control unit can be placed as a whole in the housing 2 after said control unit has been assembled, i.e. after the coil 9 and the permanent magnet 13 have been fitted on the yoke and the armature 4 has been placed on the end faces of the yoke legs 6 and 7, and after the spring 10 has been placed in position. The manufacture and assembly of the control unit are thus very simple, while both prior to and after the placing of the control unit in the housing said control unit can be accurately set as regards the preset limit value for the electric current flowing through the coil. Said limit value can be set by suitably choosing the spring characteristic and the spring force of the spring 10 in the first position of the armature 4. An alternative setting of the above limit value can be made by grinding the face 15 of the yoke leg 7, so that the gap between magnet 13 and the armature 4 can be set accurately, while the abovementioned limit value can also be set by sliding the permanent magnet 13 away from

and towards the narrowed part 16 of the yoke leg 7. The permanent magnet 13 can be fixed on the face 15 of the yoke leg 7 by means of an adhesive. However, if the permanent magnet 13 is placed loose on the face 15 of the yoke leg 7, the housing 2 can be provided with stops (not shown) which prevent the permanent magnet 13 from moving when electric current is being supplied to the coil 9 and when shocks occur.

The dimensions of the armature and the housing are preferably selected in such a way that in the second position a stop is formed by the opposite wall 17 of the housing, so that a separate stop need not be used.

In Fig. 3 the embodiment of the invention is shown in the form of loose parts. The yoke 3 consists of a base part 5 and the yoke legs 6 and 7. The yoke leg 7 has a narrowed end 16 for forming an accommodation space for the magnet 13. At the left-hand side the yoke 3 is also provided with a yoke projection 12.

The armature 4 with the armature part 11 serving as the point of action and the yoke 3 in the described form are punched out of a sheet or strip of high-grade magnetic conducting material. There is therefore no need for deformation, for example by bending. The precision of the punching further simplifies the grinding of the contact faces between armature and yoke and between magnet and yoke, which is necessary for good functioning. Moreover, the design makes it possible to grind several yokes or armatures simultaneously. Owing to the flat construction of the control unit, the armature can be guided in a simple manner in all directions through guide corrugations (not shown) of the housing, without danger of tilting. The previously manufactured coil 9 is placed on the yoke leg 6 of the finished yoke, and the magnet 13 is fitted in the accommodation space designed for it and held securely on the yoke by the magnetic field thereby created. The armature 4 is then placed on the end faces of the yoke leg 6 and of the narrowed end part 16 of the yoke leg 7.

The control unit assembled in this way can be set without further aids, while the armature 4 pivots on the pivot point 8 during the setting action (see Fig. 1). During the resetting, owing to the resetting force, which corresponds to the difference between the couple created by the permanent magnet and the couple produced by the spring, and the bearing friction thereby caused, a clean roll-off of the armature 4 is achieved, taking the end of the armature 4 clear of the stop. Furthermore, the position of the point of action of the spring force on the armature is determined in such a way that the couple caused by the spring remains accurately constant.

The assembled control unit is then placed in the housing 2, after the control pin 14 has been inserted in the hole intended for it in the wall of the housing 2. The cover 22 is subsequently fixed on the housing. All in all, the manufacture and assembly of the control unit with the housing 2 is greatly simplified.

As an alternative to the tension spring 10 described above, a compression spring can also be used, which spring acts upon points of armature 4 and yoke 5 to be specified further.

Fig. 2 shows a further embodiment of the control unit according to the invention.

The point of action 18 of the spring 10 in this embodiment is moved much higher up, i.e. the point of action 18 is situated much higher up than the pivot point 8 of the armature 4. Moving the point of action 18 of the spring 10 up means that the force-travel characteristic of the spring in the control process (tripping) is flatter.

Said point of action is preferably placed further up without increasing the mass of the armature. The latter is of importance for better shock resistance of the control unit. In the case of the embodiment shown in Fig. 2 the point of action 18 is advantageously and simply produced by the armature part 11 of the armature 4 being situated at an angle relative to the armature 4.

Moreover, in the embodiment of Fig. 2 at the armature end 20 the magnetically effective surface of the armature end is limited in such a way in the lengthwise and breadthwise direction of the armature 4 that said surface corresponds to the end face of the yoke leg 7 facing the armature, in particular the narrowed end part 16 of the yoke leg 7. This limitation is achieved in a simple way by providing the armature with a recess 21 which adjoins the narrowed end part 16 of the yoke leg 7. The result of the pole shoe thus formed is that the magnetic lines of flux do not fan out as rapidly when the armature 4 is taken into its second position, so that the control unit is more tolerant as regards air gaps. This is important in particular when corrosion-resistant covering layers are being applied to the pole faces, in connection with the thickness(es) thereof.

[On drawings, Figs.1 and 2]:

Z = S

Claims

1. Control unit for an electric switch, comprising a yoke of magnetic material which consists of a base part and two legs which extend at a distance from each other and in the same direction from the base part, and at right angles thereto, an armature made of magnetic material which bridges the free ends of the yoke legs and is movably supported, a permanent magnet which is fitted in such a way that the magnetic lines of flux run through the armature and the yoke, a coil fitted on the yoke, and spring means which at one side act upon an armature part extending beyond a yoke leg face which faces away from the other yoke leg, the armature assuming a first position under the influence of the magnetic field of the permanent magnet, against the spring force of the spring means, and being able to assume a second position under the influenc of the magnetic field created by an electric current which flows through the coil and exceeds a preset limit value,

characterized in that at the other side the spring means act upon a yoke projection extending beyond the abovementioned yoke leg face at a distance from the projecting armature part, and in that armature and yoke are made of flat magnetic material.

2. Control unit according to Claim 1, provided with a housing, characterized in that armature and housing are dimensioned in such a way that a stop for the armature in the second position is formed by an opposite wall of the housing.

3. Control unit according to Claim 1 or 2, characterized in that the point of action of the spring means on the projecting armature part is situated at a greater distance from the yoke than the face of the armature facing away from the yoke.

4. Control unit according to Claim 3, characterized in that the projecting armature part is situated at an angle relative to the armature.

5. Control unit according to Claim 1, 2, 3 or 4, characterized in that one yoke leg is broader than the other yoke leg and in the direction of the armature merges into a narrower part, in order to form an accommodation space for the permanent magnet.

6. Control unit according to Claim 5, characterized in that the permanent magnet can be slid towards and away from the narrowed leg.

7. Control unit according to one of the preceding claims, characterized in that at the armature end which can be moved away from the corresponding yoke leg the magnetically effective surface of the armature is limited in the lengthwise and breadtiwise direction of the armature in such a way that said surface corresponds to the end surface of the corresponding yoke leg facing the armature.

8. Control unit according to Claim 6, characterized in that the armature at the side facing the yoke legs is provided with a recess which is situated between the yoke legs and adjoins the yoke leg away from which the armature can be moved.

9. Method for manufacturing the control unit according to one of the preceding claims, in which the armature and the yoke are punched out of a sheet of magnetic conducting material, the armature, the yoke, the coil and the permanent magnet are assembled, the spring means are attached to the armature and yoke, and the entire assembly of armature, yoke, coil, magnet and spring means is fitted in the housing, and the housing cover is fixed on the housing.

fig-1

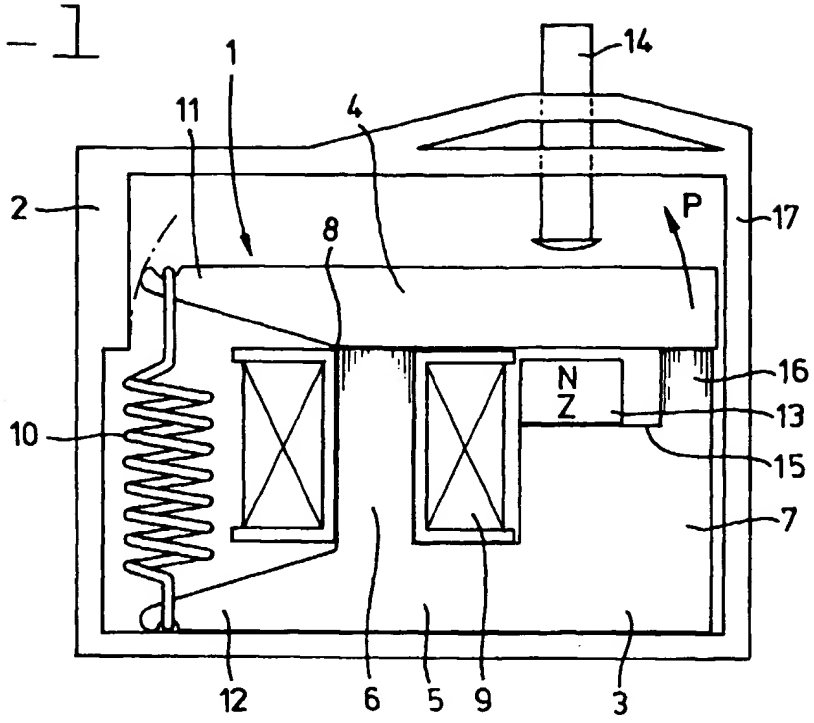
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fig-2

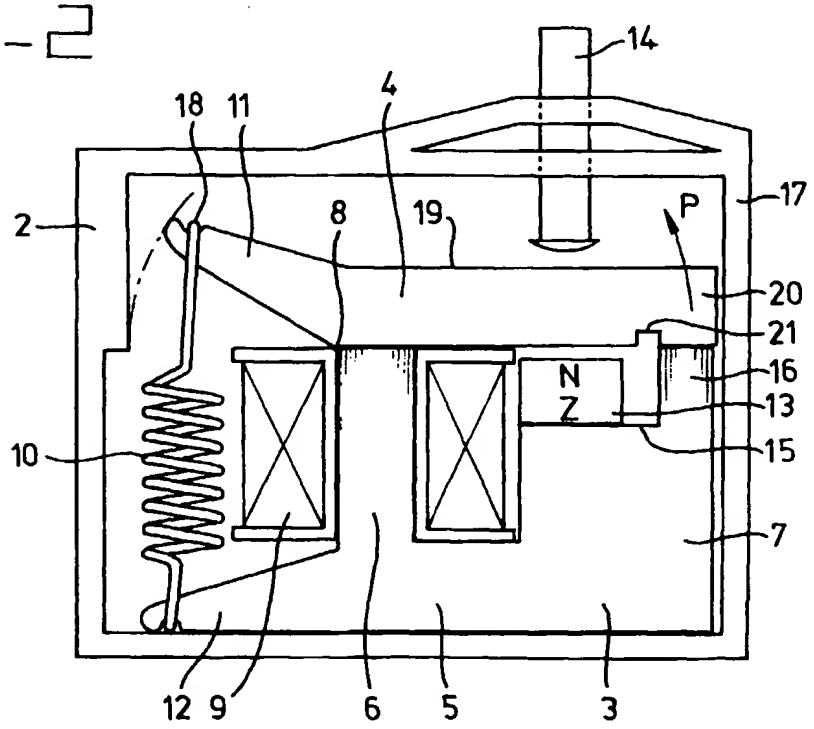
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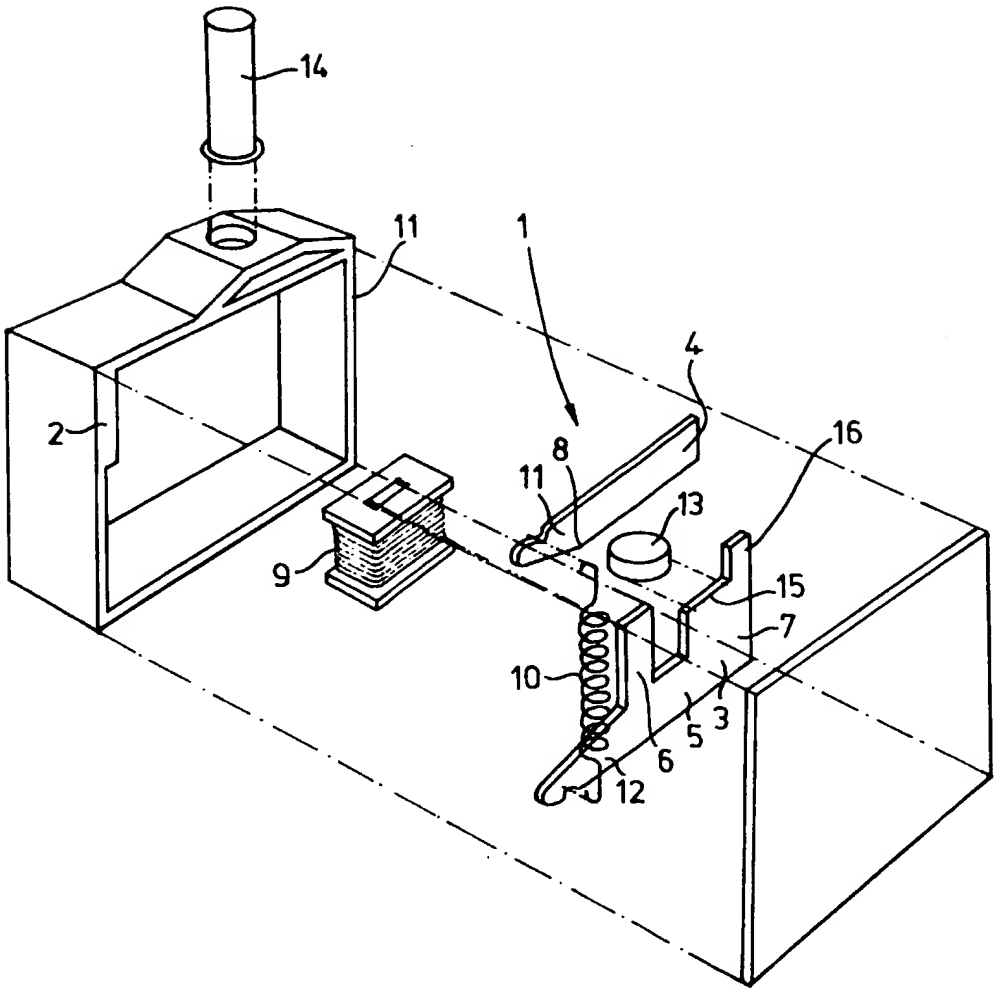
Fig-3



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EUROPEAN SEARCH REPORT

Application Number
EP 97 20 3319

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	DE 15 64 531 A (RABBEAU KURT) 22 January 1970 * page 8, paragraph 1 - paragraph 3 * * page 14, last paragraph - page 15, paragraph 1 * * figure 1Q *	1-4	H01H71/32
Y	FR 2 383 518 A (BACO SA ANCT BAUMGARTEN CONST) 6 October 1978 * claim 1 *	1	
Y	EP 0 337 900 A (MERLIN GERIN) 18 October 1989 * abstract *	2	
Y	FR 2 075 891 A (FELTEN & GUILLEAUME) 15 October 1971 * claim 9 *	3,4	
A	FR 2 309 031 A (MANG ETS GERARD) 19 November 1976 * claim 1 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01H
A	FR 1 559 815 A (INDUSTRIE ELECTRIQUE DE LA SEINE) 14 March 1969 * figures *		
A	FR 1 479 460 A (INDUSTRIE ELECTRIQUE DE LA SEINE) 20 July 1967 * figures *		
A,D	FR 2 697 670 A (MERLIN GERIN) 6 May 1994		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 February 1998	Desmet, W

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